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MEMORANDUM FOR PRS (In-House Publication)

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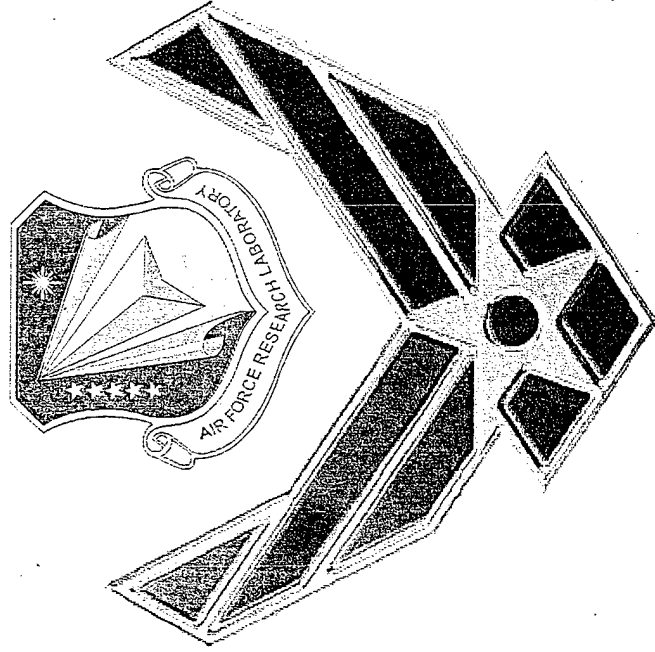
SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-VG-2003-099**

5642 C.T. Liu; M. Yen, "Investigating the Effects of Confining Pressure on Cumulative Damage and the Constitutive Behavior of a Particulate Composite Material"

International Conference on Mechanical Behavior of Materials
(Geneva, Switzerland, 25-29 May 2003) (Deadline: 14 May 2003)

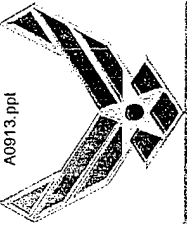
(Statement A)

Investigating the Effects of Confining Pressure on Cumulative Damage and the Constitutive Behavior of a Particulate Composite Material

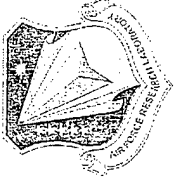


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Objectives



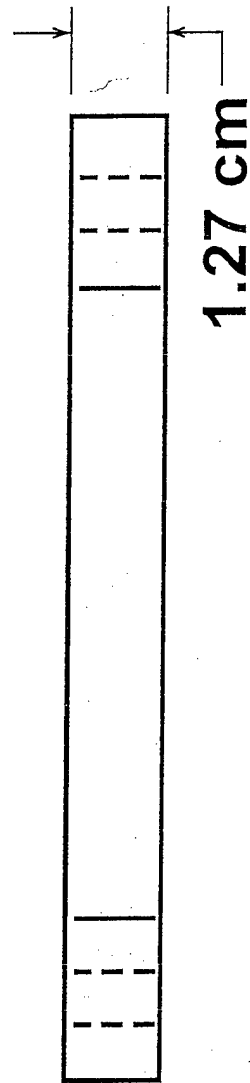
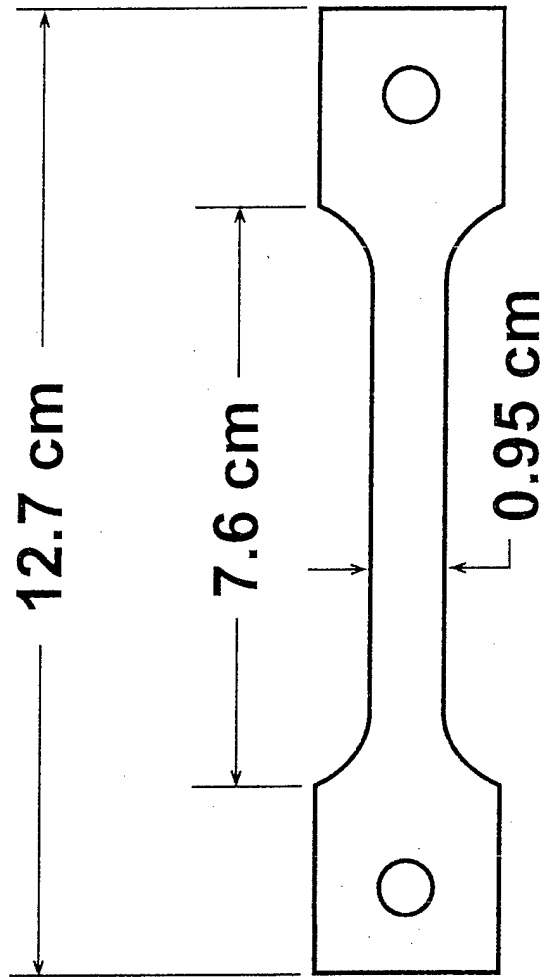
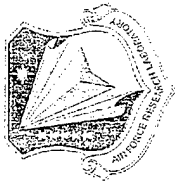
- Investigate the Effects of Strain Rate and Confining Pressure on Cumulative Damage and the Constitutive Behavior of a Particulate Composite Material.

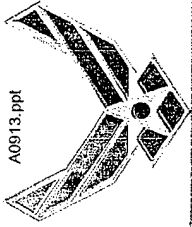
— Strain Rates: 0.73 cm/cm/min, 18.18 cm/cm/min, and 72.73 cm/cm/min

— Confining Pressures: Ambient and 1000 psi

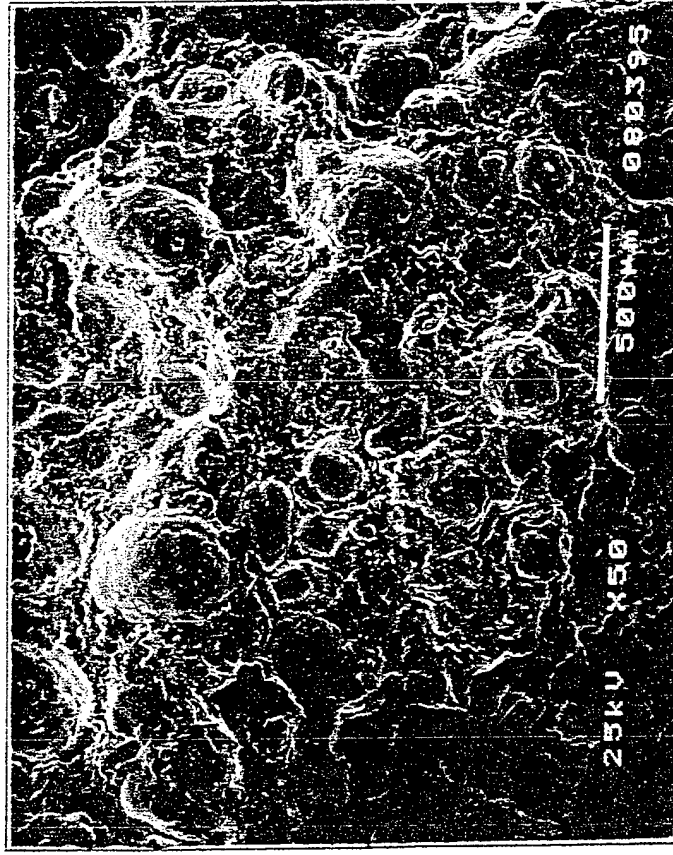
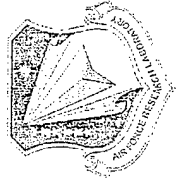


Specimen Geometry

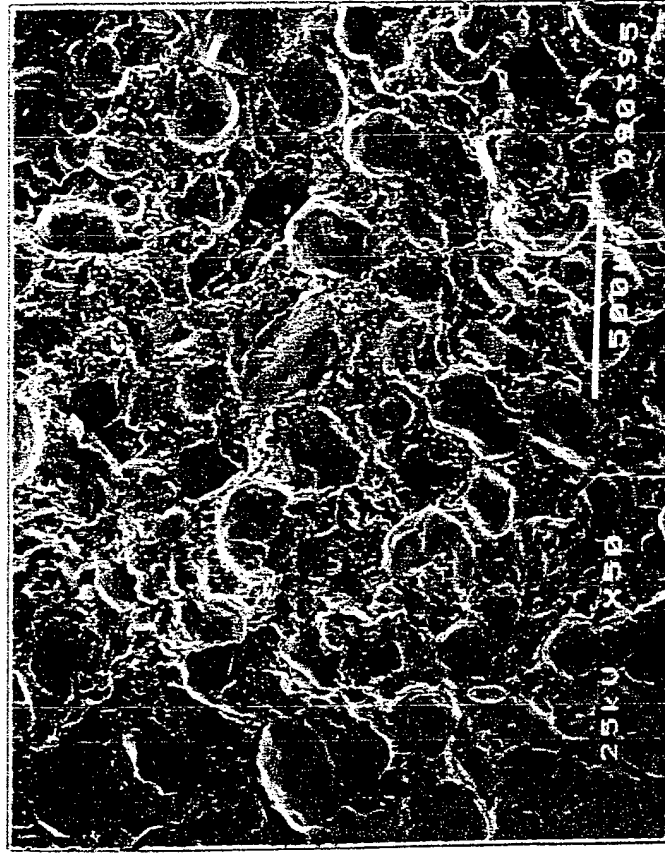




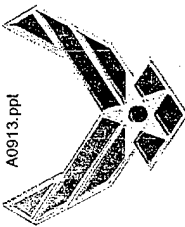
Fracture Surface Under Different Confining Pressures



Pressure = 72.7 psi

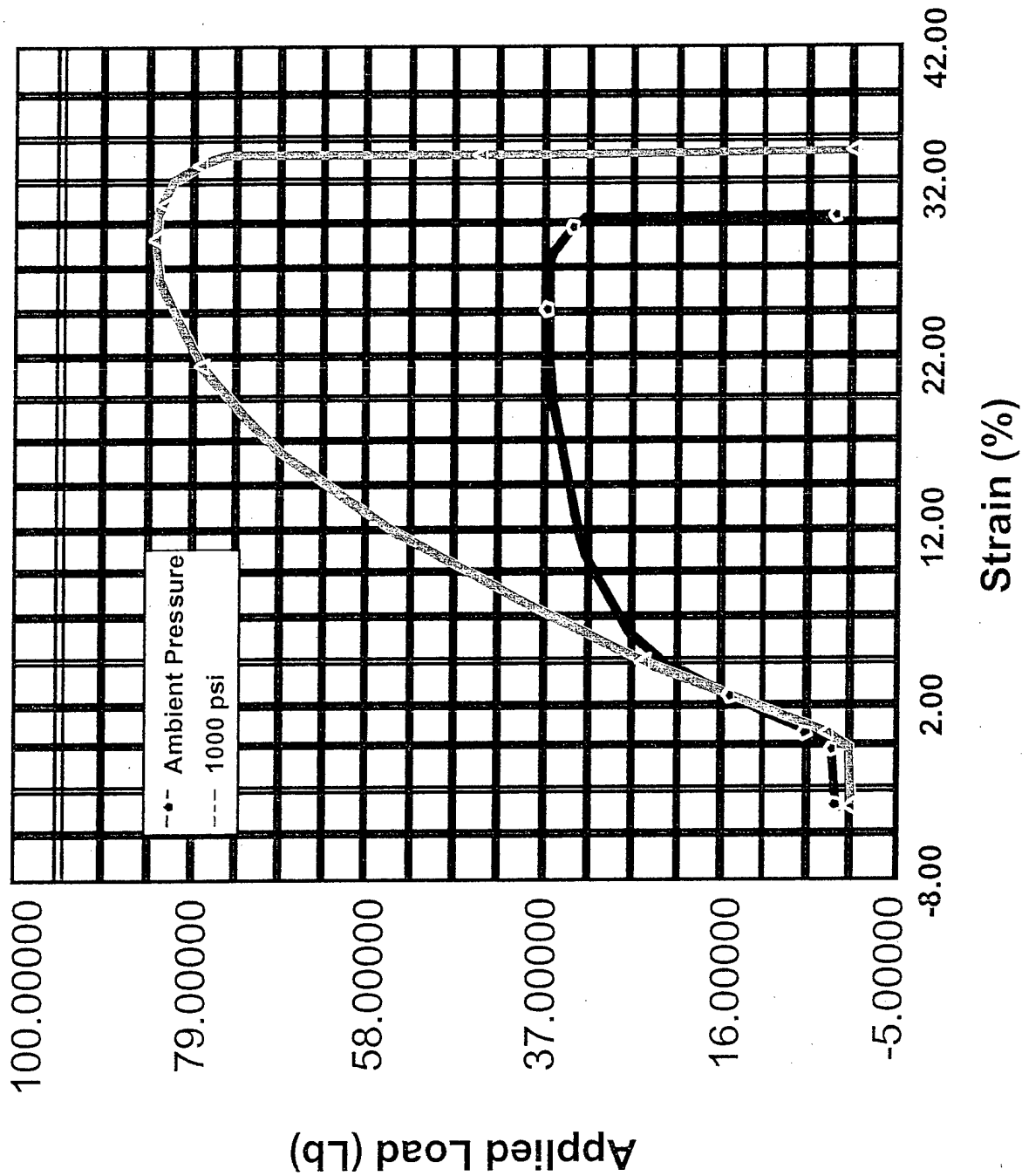
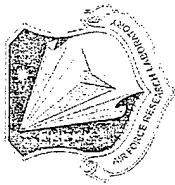


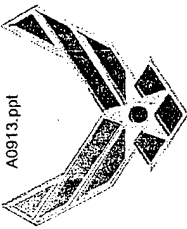
Pressure = 1744 psi



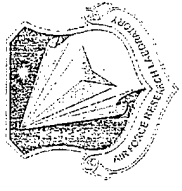
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Applied Load Vs. Strain (Strain Rate=18.8 min⁻¹)

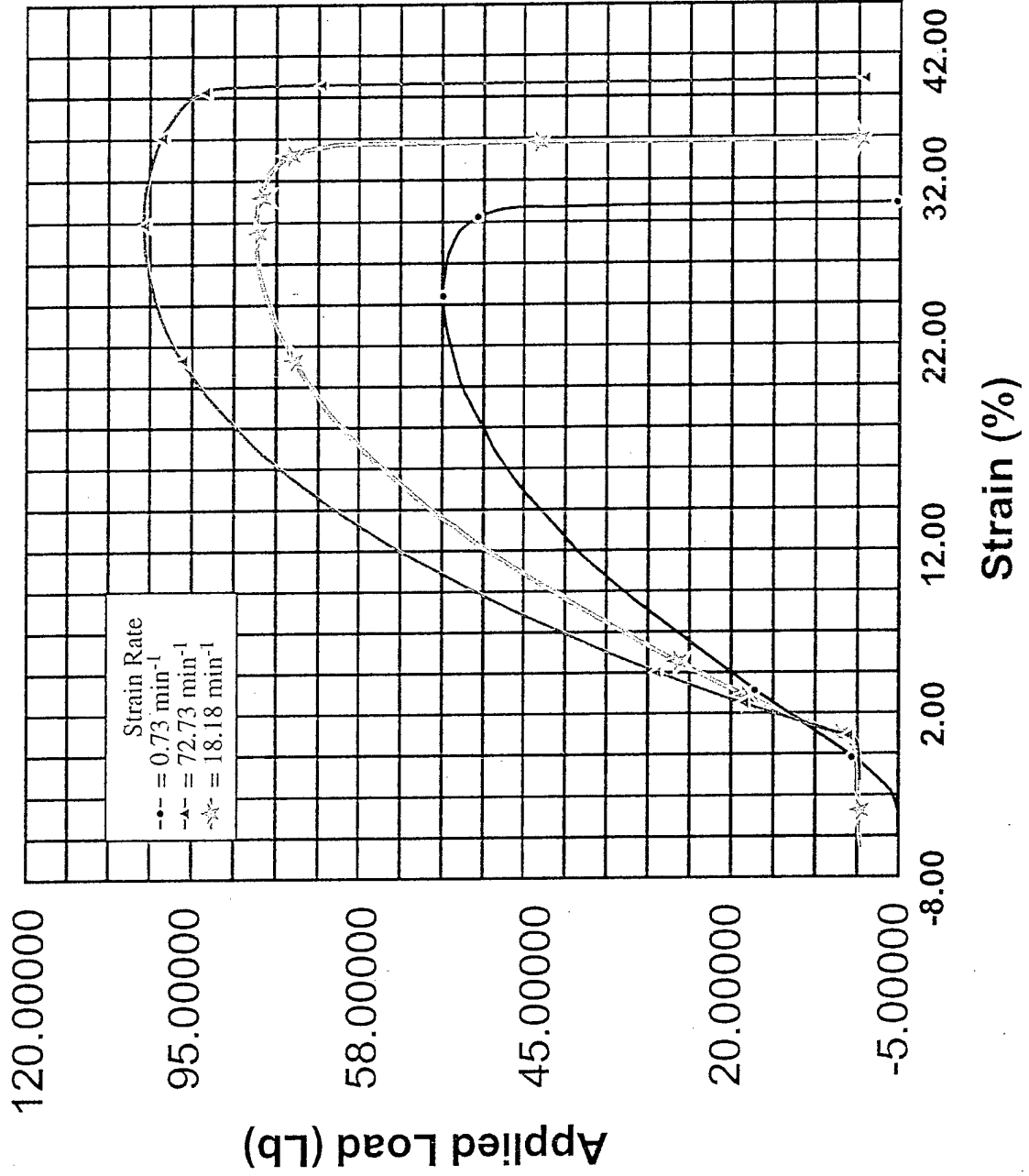


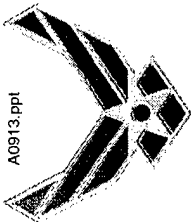


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Applied Load Vs. Strain (Confining Pressure=1000 psi)

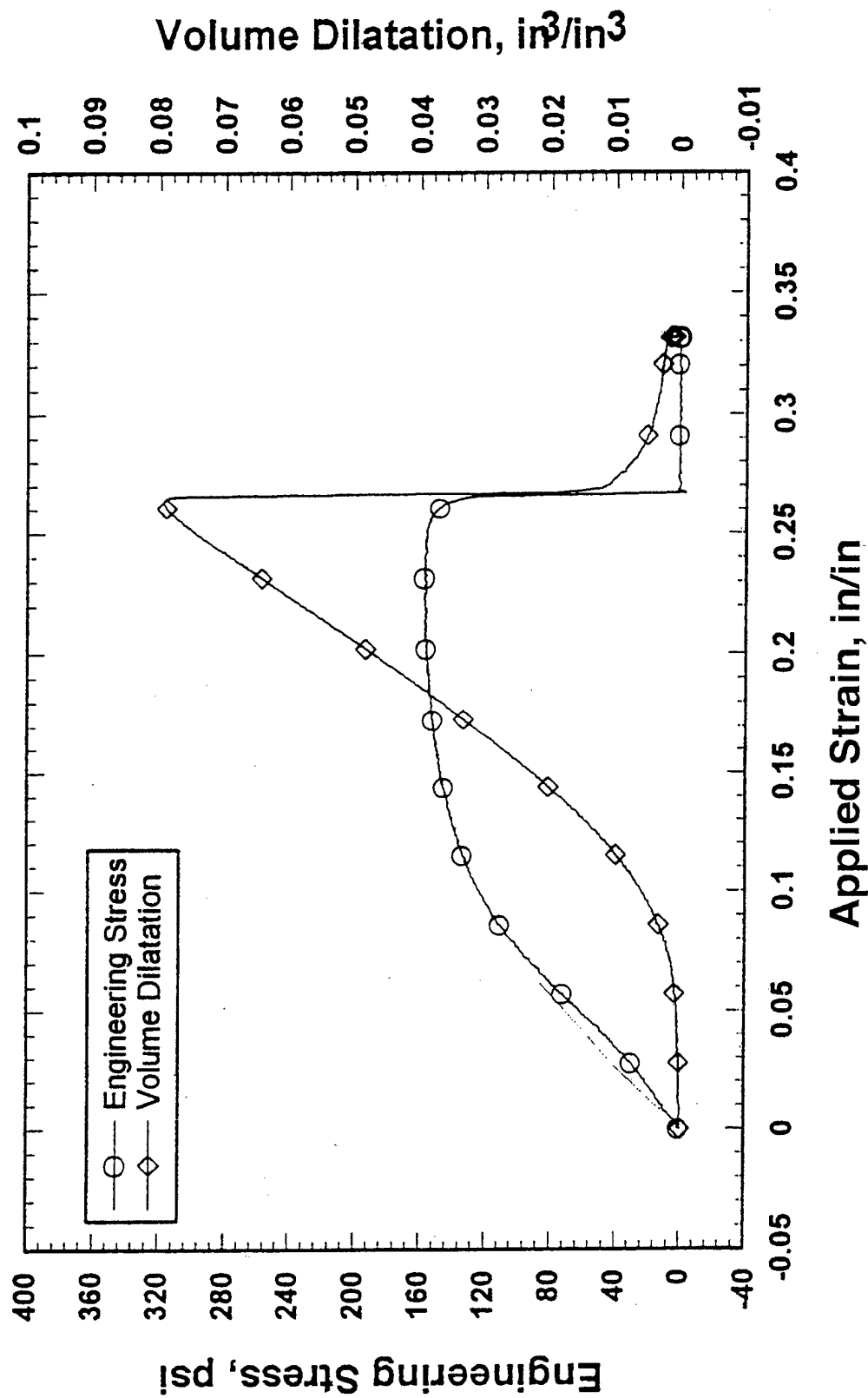


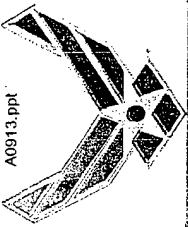


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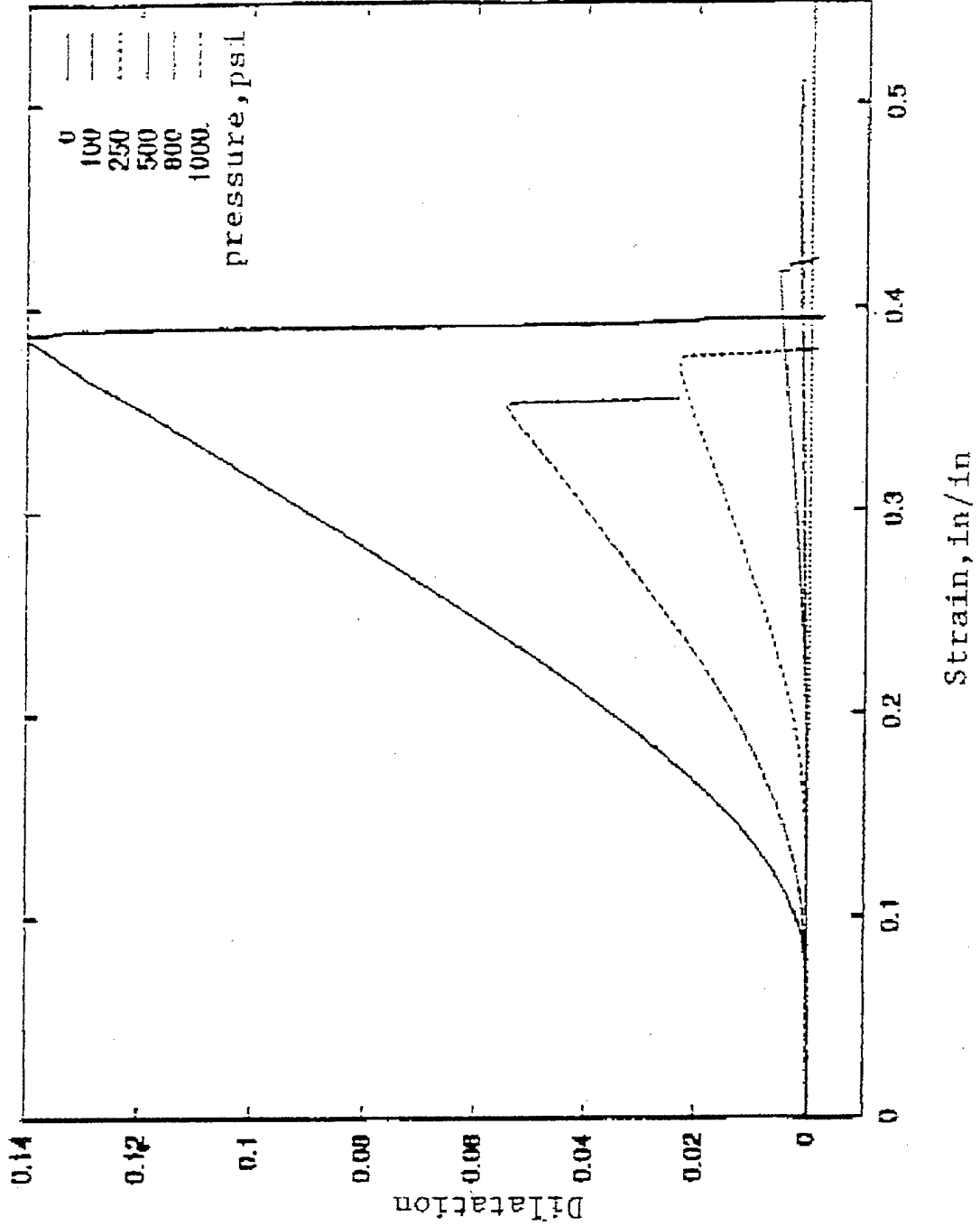
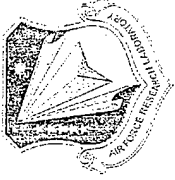
Engineering Stress and Volume Dilatation Vs. Applied Strain

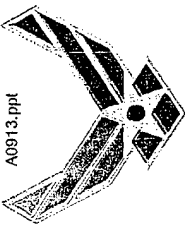
(Strain Rate=0.73 min⁻¹ and Ambient Pressure)





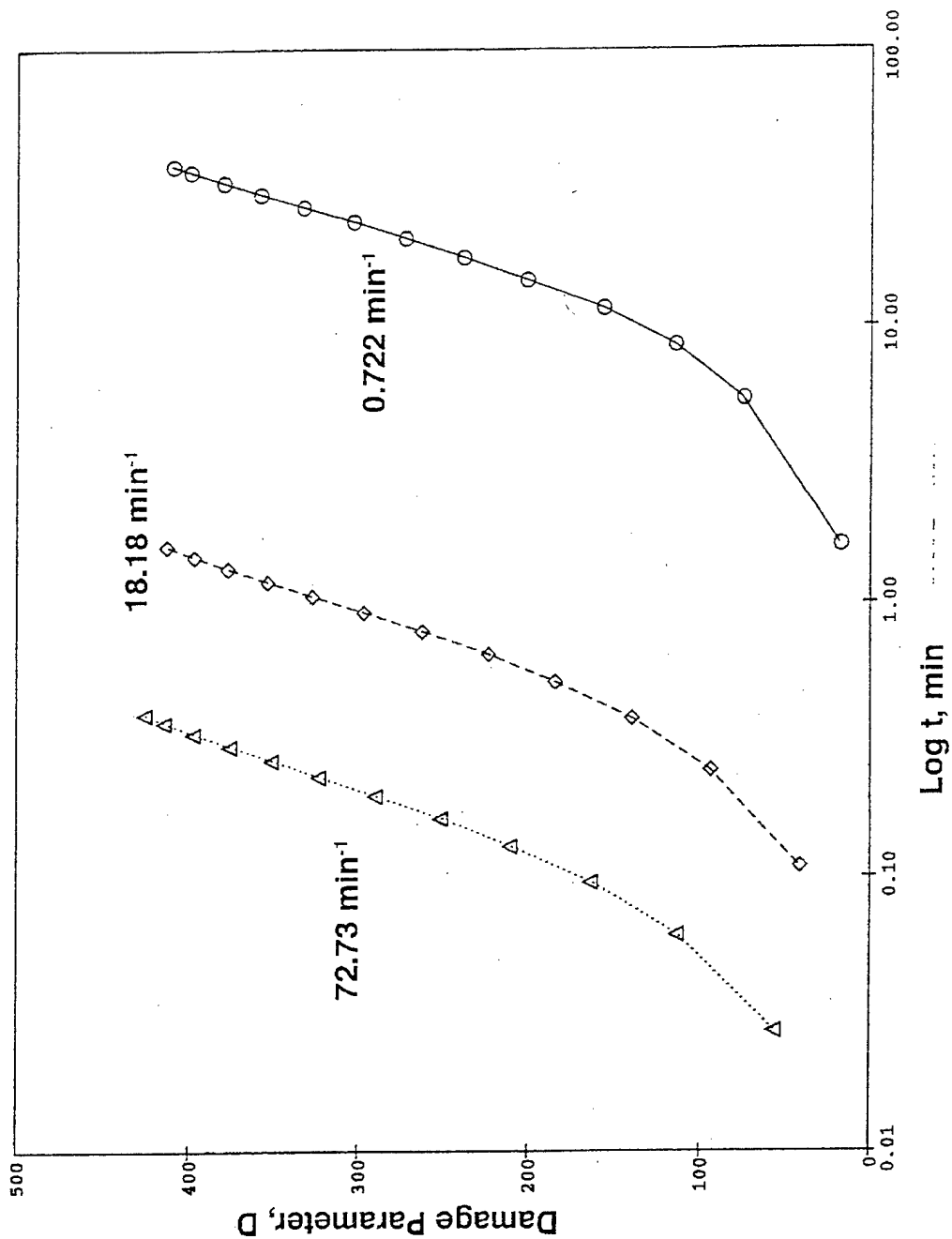
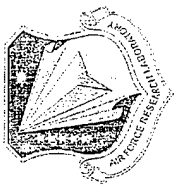
Volume Dilatation Vs. Confining Pressure

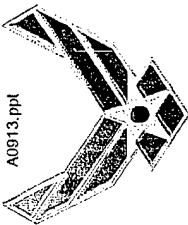




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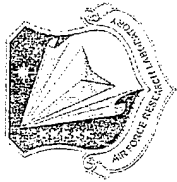
Damage Parameter Vs Time, semi-log scale



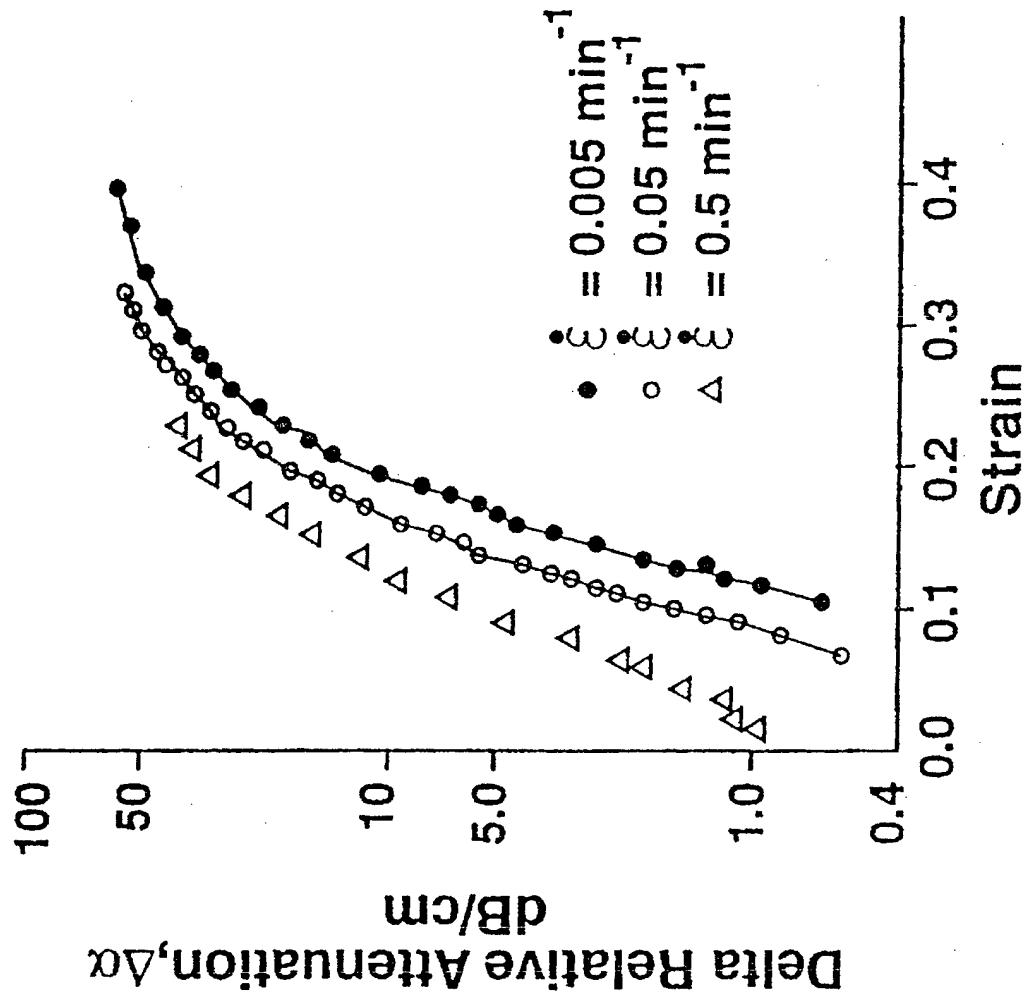


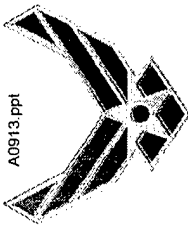
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Relative Change in Acoustic Attenuation Versus Strain



(constant strain rate loading)

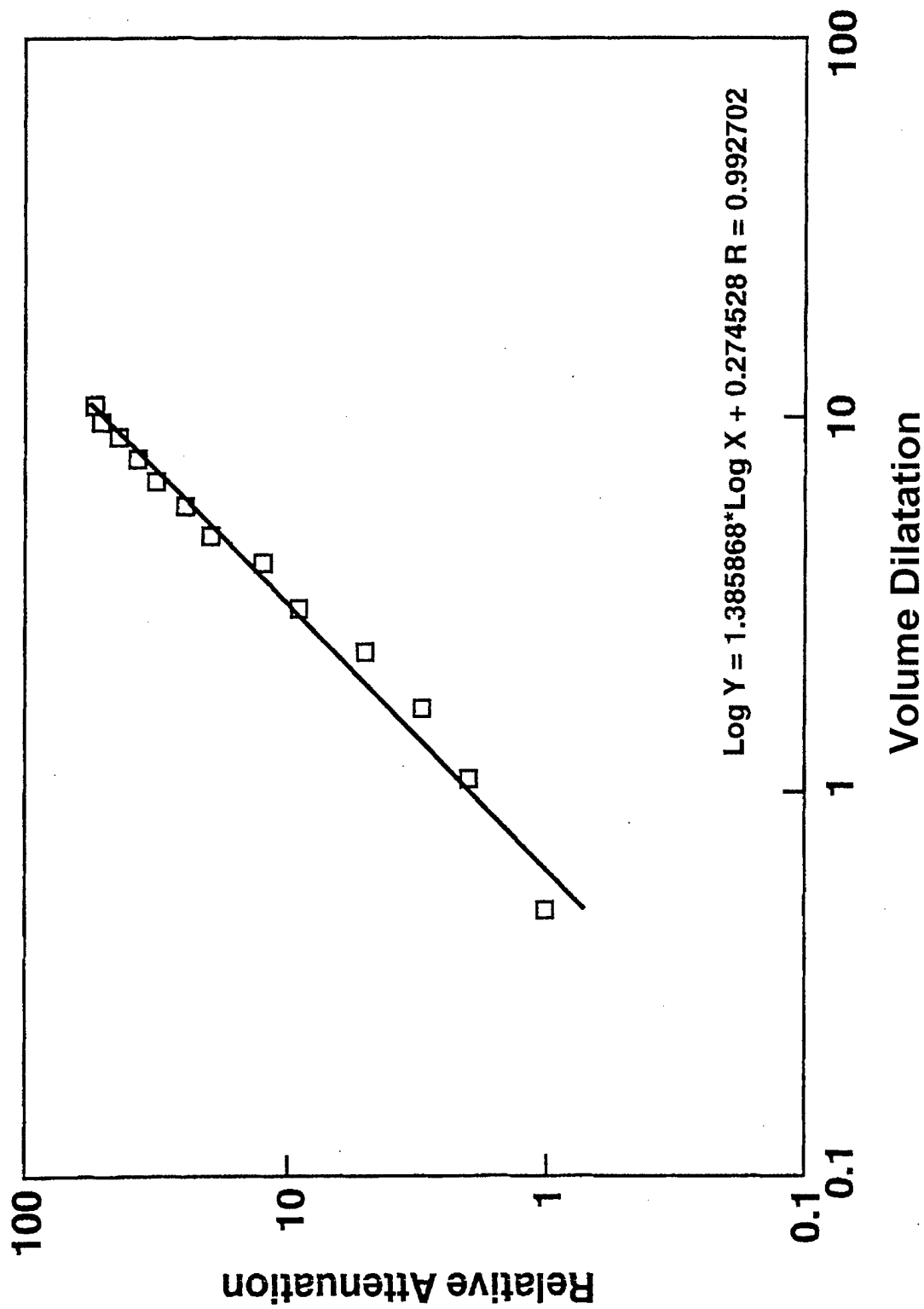


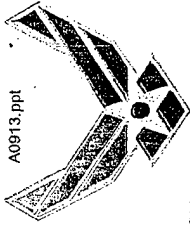


Relative Attenuation of Acoustic Energy Versus Volume Dilatation

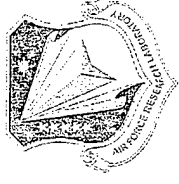


(monotonic loading)

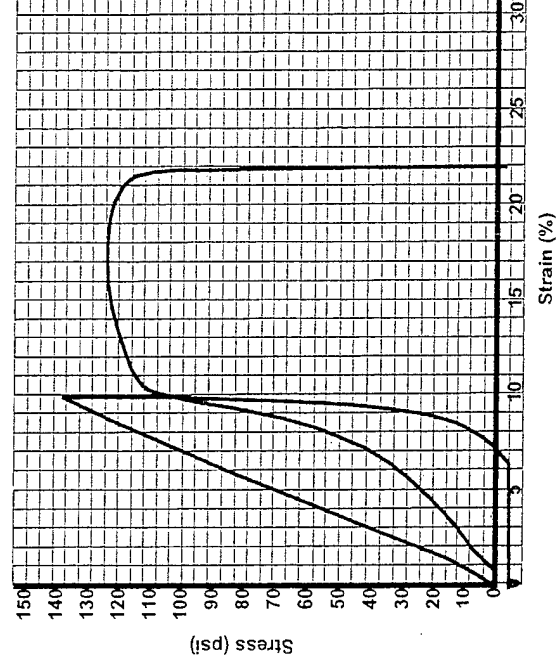
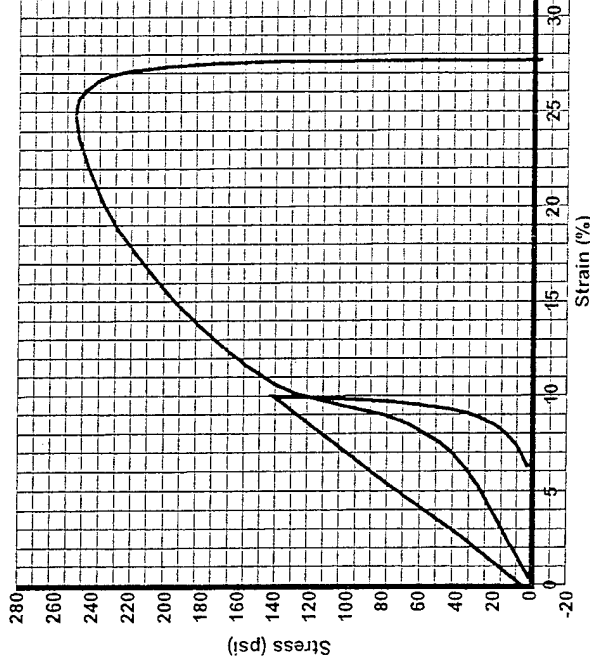


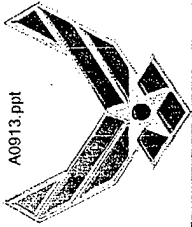


Under A High Confining Pressure, Microcracks Can Develop in the Highly Filled Particulate Composite Material

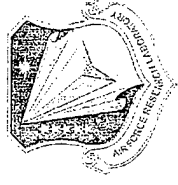


- * The development of micro-cracks under multi-axial loading conditions results in a decrease in modulus.
- * For a given number of defects (micro-cracks or micro-voids), the modulus (volume dilatation) is insensitive (sensitive) to the type of defects.





Conclusions



- For a given strain rate, confining pressure has significant effects on the maximum stress and the applied strain for the onset of dilatation.
- For a given strain rate, confining pressure has no effect on the Modulus and insignificant effect on the rupture strain.
- For a given time, the strain rate has a significant effect on the damage intensity.
- The critical damage intensity is insensitive to the strain rate.